

DOMAIN FIVE

# EXERCISE SELECTION, TECHNIQUE, AND TRAINING INSTRUCTION

EXAM WEIGHT 15%



INTERNATIONAL  
SPORTS SCIENCES  
ASSOCIATION

Exercise selection is one of the primary acute training variables a personal trainer will consider when designing an exercise program. Exercise selection can determine factors such as the potential intensity of the exercise, training outcome, or even enjoyment of the program by the client.

## **Injury Prevention - Chapter 13**

- Common reasons a client may have an injury during exercise
  - ▶ Misuse of acute training variables
  - ▶ Improper training progression
    - ◆ Progressions: modifications to acute training variables that increase the challenge of a movement pattern
      - Increase in movement complexity can increase the challenge
        - Pair two movements together (i.e., reverse lunge with rotation)
      - Increase in range of motion
      - Increase in load
      - Increase in tempo
    - ◆ Regressions: modifications to acute training variables that decrease the challenge of a movement pattern
      - Keeping movement simple
        - Fewer movement patterns and joint movements can act as a regression
          - ◆ Teaching individual aspects of a complex movement pattern before combining them
      - Decrease in range of motion
      - Decrease in load
      - Decrease in tempo
  - ▶ Poor mobility/flexibility
    - ◆ Altered arthrokinematics: altered movement of joint surfaces
    - ◆ Synergistic dominance: when a synergist (helper) muscle takes over a movement pattern when the prime mover fails or is too weak to control the movement
  - ▶ Poor exercise form/technique
    - ◆ Observation of faulty movement patterns during initial assessments, while executing exercises, and during reassessments
  - ▶ Poor preparation for movement
  - ▶ Insufficient energy/exhaustion
- Periodization
  - ▶ Using proper periodization is a key component of injury prevention, reducing mental and physical fatigue, and avoiding overtraining.

- ♦ Supercompensation: the post-training period during which the trained function/parameter has a higher performance capacity than it did before the training period
- ♦ Overtraining: caused by cumulative microtrauma (cellular damage from an overreaching episode that gets worse and worse over time)
- ♦ Overreaching: an accumulation of training or non-training stress resulting in a short-term decrease in performance capacity
- ♦ Overtraining syndrome (OTS): a maladapted response to excessive exercise without adequate rest, resulting in perturbations of multiple body systems (neural, endocrine, and immune) coupled with mood changes
- Recovery
  - ▶ As the intensity and volume of training sessions increase, the time needed to optimize recovery between sessions will also increase.
  - ▶ Methods of recovery will include restful sleep, sound nutrition, and low-intensity movement or active recovery practices.
    - ♦ Recovery promotes blood flow and flexibility.
    - ♦ Active recovery is low-intensity exercise or activity that can promote and accelerate muscular and metabolic recovery.
    - ♦ Generally, these methods are more beneficial for promoting and accelerating recovery from higher-intensity activities.
    - ♦ The average adult between the ages of 26 and 64 years of age should get 7-9 hours of sleep each night
- Rest
  - ▶ The number of sets or repetitions can vary within a workout.
    - ♦ Generally, as the number of sets decreases, the number of individual exercises in a workout will increase.
    - ♦ In the same manner, as the number of repetitions increases, the load used will likely decrease.
    - ♦ As load decreases, the exerciser may increase the tempo of the exercise along with their perceived intensity throughout a set.
    - ♦ As the intensity increases, the rest needed will increase or decrease depending on the phase of training the exerciser is in and the desired adaptation.
      - Those seeking the adaptation of endurance may shorten rest periods, while those seeking power may increase the rest period.

## Communication Principles - Chapter 13

- Communication
  - ▶ Nonverbal
    - ♦ Body language
      - Involves gestures and body movements
    - ♦ Spatial relations
      - Proxemics: the study of what is communicated by the way a person uses personal space
  - ▶ Listening
    - ♦ Active listening: paraphrasing or stating in one's own words what someone has just said
    - ♦ Empathic listening: the ability to understand how the clients feel and empathize with them
  - ▶ Verbal
    - ♦ Paralanguage
      - Components of speech such as tone, pitch, facial expressions, cadence, and hesitation noises
        - Articulation: the ability to pronounce distinctly—to enunciate
        - Visual learners: people who learn by seeing information
        - Auditory learners: people who learn by hearing information
        - Kinesthetic learners: people who learn by physical touch
    - ♦ Language choices
      - Keeping it clear and simple
        - No = “Straighten and maintain a neutral spine”
        - Yes = “Lengthen your spine” or “Elongate your spine”
      - Shouldn't be too complex (i.e., “Dorsiflex your ankle”)
      - Articulation
        - The ability to enunciate distinctly
    - ♦ Cueing: to give a reminder or direction
      - Visual
      - Verbal
        - Avoiding overinstructing
        - Avoiding use of technical language
        - If the client is not responding to the cue
          - ♦ Trainer may need to try a different cue
          - ♦ Movement might be too complex for the client
      - Kinesthetic
        - Hands-on cueing that should be approved by the client

## Select the Appropriate Exercises - Chapter 13

- Exercise selection
  - ▶ When considering which exercises to select for a program, the trainer must consider the following:
    - ◆ Target muscle groups or movement patterns
    - ◆ Muscle groups or movement patterns to avoid that will prevent injury or overuse
    - ◆ Skill or comfort level of the client with specific movements
    - ◆ Available tools, space, or exercise equipment
  - ▶ Variations of each foundational movement pattern
    - ◆ Different equipment
    - ◆ Starting positions
    - ◆ Exercise machines
    - ◆ Surfaces
    - ◆ Grips
- Proper form
  - ▶ “Ideal” form will vary by client because flexibility, joint mobility, strength, and body size will vary.
  - ▶ Proper form and technique can prevent injury and encourage optimal muscular recruitment during a movement pattern.
- Movement categories
  - ▶ Hinge
    - ◆ Hip hinge: a forward and backward movement of the upper body while the hips remain at the same height and move back
    - ◆ A foundational movement for many exercises and should be mastered early in an exercise program
    - ◆ Barbell deadlift
      - Prime movers: hamstrings, quadriceps, gluteus maximus
      - Form
        - Feet just outside hip width
        - Back flat
        - Hip hinge to standing position
    - ◆ Dumbbell Romanian deadlift (RDL)
      - Prime movers: hamstrings, glutes
      - Form
        - Keeping a slight bend in the knees
        - Squeezing the glutes and hamstrings
        - Not allowing the upper body to pull the weight up

- ♦ Kettlebell swing
  - Prime movers: hamstrings, glutes
  - Form
    - Hinging from the hips
    - Keeping the back flat
    - Powerful knee and hip extension
    - Arms and shoulders remain relaxed throughout the movement
      - ♦ Forward movement of the kettlebell is a result of the hips (not the arms).
- ♦ Single-leg RDL
  - Prime movers: hamstrings, glutes
  - Form
    - Soft bend in the knee
    - Back flat
    - Hips square
    - Hinging at the hips
    - Squeezing the glutes and hamstring to control the movement back to the starting position

► Push

- ♦ Can happen vertically (overhead) or horizontally (anteriorly) and everything in between
- ♦ Push-up
  - Prime mover: pectoralis major
  - Form
    - Plank position
    - Lowering until the elbows are at 90 degrees
    - Pressing through the hands
- ♦ Standing cable chest press
  - Prime mover: pectoralis major
  - Form
    - Cable set at chest height
    - Feet parallel or staggered
    - Pressing the arms forward but not locking the elbows
- ♦ Bench press
  - Prime mover: pectoralis major

- Form
      - Head, shoulder, and glutes in contact with the bench
      - Pronated grip
      - Lowering the bar until it touches the chest (or just above the chest)
      - Pressing back up to the starting position
  - ♦ Dumbbell chest press
    - Prime mover: pectoralis major
    - Form
      - Feet on floor
      - Head, shoulders, and glutes in contact with the bench
      - Keeping the wrists over the elbows
  - ♦ Dumbbell seated overhead press
    - Prime mover: deltoid
    - Form
      - Feet flat on the floor
      - Extending the elbows while keeping the shoulders down and away from the ears
      - Avoiding arching the back
  - ♦ Machine chest press
    - Prime mover: pectoralis major
    - Form
      - Glutes, upper back, and head in contact with the seat
      - Keeping the shoulders down and away from the ears
      - Avoiding arching the back
  - ♦ Assisted dips
    - Prime mover: triceps brachii
    - Form
      - Selecting the desired assistance
      - Slowly flexing the elbows to approximately 90 degrees
      - Avoiding elevation of the shoulders
- Pull
- ♦ Can happen vertically (from overhead) and horizontally (posteriorly) with additional angles in between
  - ♦ Barbell bent-over row
    - Prime mover: latissimus dorsi

- Form
    - Gripping the bar just outside shoulder width
    - Hinging from the hips
    - Pulling the weight toward the belly button
    - Elbow should move straight back
- ♦ Single-arm cable row
  - Prime mover: latissimus dorsi
  - Form
    - Handle height set between belly button and chest
    - Feet hip-width apart or staggered stance
    - Keeping the shoulders down and away from the ears
    - Pulling the handle toward the torso
- ♦ Seated row machine
  - Prime mover: latissimus dorsi
  - Form
    - Relaxing the shoulders and sitting tall
    - Pulling the handles toward the mid abdomen
- ♦ Lat pulldown
  - Prime mover: latissimus dorsi
  - Form
    - Gripping the bar just outside shoulder width
    - Relaxing the shoulders down
    - Pulling the bar down toward the chest
    - Avoiding swinging or excessively leaning back
- ♦ Pull-up
  - Prime mover: latissimus dorsi
  - Form
    - Relaxing the shoulders
    - Pulling the body toward the bar
- ♦ Machine-assisted pull-up
  - Prime mover: latissimus dorsi
  - Form
    - Adjusting to the desired amount of assistance
    - Relaxing the shoulders
    - Pulling the body toward the bar



- ♦ Barbell upright row
  - Prime mover: deltoids
  - Form
    - Rolling the shoulders back and down
    - Pulling the barbell up, leading with the elbows
    - Avoiding elevation of the shoulders

► Squat

- ♦ Mobility and muscle flexibility in the calves, adductors, glutes, and hip flexors are imperative.
  - For clients with poor mobility or muscular imbalances, these body regions may need to be addressed with myofascial release, stretching, or an effective warm-up to prevent injury.
- ♦ Goblet squat
  - Prime movers: quadriceps, glutes
  - Form
    - Feet just outside the hips
    - Keeping the neck neutral
    - Ideal end of range: glutes just below the crease of the hips and the elbows on the inside of the knees
- ♦ Barbell back squat
  - Prime movers: quadriceps, glutes
  - Form
    - Placing the bar either on the trapezius and shoulder (high bar) or just above the spine of the scapula (low bar)
    - Hinging from the hips while bending the knees
    - Pressing through the midfoot
- ♦ Dumbbell split squat
  - Contralateral loading: loading the body on the opposite side of the work being executed
  - Ipsilateral loading: loading the body on the same side as the work being executed
  - Prime movers: quadriceps, glutes
  - Form
    - Soft bend in both knees
    - Keeping the knees in alignment with the ankles
    - Pressing through the toes of the back foot and the midfoot on the forward foot
- ♦ Seated leg press
  - Prime movers: quadriceps, glutes

- Form
  - Keeping the back and head on the seat
  - Pressing through the midfoot
- ♦ Angled leg press
  - Prime movers: quadriceps, glutes
  - Form
    - Keeping the back and head on the seat
    - Pressing through the midfoot

► Lunge

- ♦ During a lunge in the sagittal plane, the prime mover at the hips will be the gluteus maximus, at the knees it will be the quadriceps, and at the ankles it will be the calf muscles.
- ♦ As the lunge becomes more of a diagonal or frontal plane movement, the prime movers remain the same, but there will be an added element with musculature along the lateral side of the hips, knees, and ankles providing synergistic support.
- ♦ Dumbbell forward lunge
  - Prime movers: quadriceps, glutes
  - Form
    - Bending the back knee toward the floor until the forward knee reaches approximately 90 degrees of flexion
    - Pressing through the midfoot of the forward foot and the toe of the back foot
- ♦ Reverse lunge
  - Prime movers: quadriceps, glutes
  - Form
    - Bending the back knee toward the floor until the forward knee reaches approximately 90 degrees of flexion
    - Pressing through the midfoot of the forward foot and the toe of the back foot
- ♦ Step-up
  - Prime movers: quadriceps, hamstrings, glutes
  - Form
    - Pressing through the midfoot
    - Squeezing the glutes
- ♦ Lateral lunge
  - Prime movers: quadriceps, glutes

- Form
  - Stationary foot remains straight
  - Ankle, knee, and hip should be aligned in bent leg
- ♦ Reverse lunge with rotation
  - Prime movers: quadriceps, glutes, core
  - Form
    - Keeping elbows tight to the body
    - Rotating the torso and weight in hand as far as possible in the direction of the forward leg
    - Pressing through the midfoot of the forward foot and the toe of the back foot

► Locomotion

- ♦ Locomotion is a broad term referring to the ability to move from one place to another using the limbs.
- ♦ Farmer carry
  - Prime movers: quadriceps, core
  - Form
    - Slow, steady pace
- ♦ Suitcase carry
  - Prime movers: quadriceps, core
  - Form
    - Slow, steady pace
    - Avoiding leaning to the side of the load
- ♦ Dumbbell walking lunge
  - Prime movers: quadriceps, glutes
  - Form
    - Bending back knee toward the floor until the forward knee reaches approximately 90 degrees of flexion
    - Pressing through the midfoot of the forward foot and the toe of the back foot
- ♦ Monster band walk
  - Prime movers: tensor fasciae latae, glutes
  - Form
    - Placing mini band around both legs at the knees or ankles
    - Slightly flexing the hips
    - Walking in a diagonal pattern forward, stepping laterally
- ♦ Lateral band walk
  - Prime movers: glutes

- Form
  - Placing a mini band around both legs at the knees or the ankles
  - Ensuring the knee remains above the ankle

► Core

- ♦ Core exercises specifically help to train the muscles of the pelvis, lower back, hips, and abdomen.
  - When there is weakness or dysfunction in any of these areas, postural and stability issues are likely.
- ♦ A strong core contributes to overall strength, power production, balance, and stability, as well as lowering the incidence of low-back pain.
- ♦ Forearm plank
  - Prime mover: core
  - Form
    - Positioning the forearms on the floor and the elbows directly under the shoulders
    - Body maintains a straight line from the heels to the back of the head
    - Tucking the hips (posterior pelvic tilt) by squeezing the glutes
- ♦ Glute bridge
  - Prime movers: core, glutes
  - Form
    - Pressing through the heels
    - Squeezing the glutes
- ♦ Abdominal crunch
  - Prime mover: rectus abdominus, external oblique
  - Form
    - Keeping the shoulders relaxed and away from the ears
    - Gently tucking the chin
    - Lifting the shoulder blades off the floor
- ♦ Abdominal double crunch
  - Prime mover: rectus abdominus, rectus femoris, external oblique
  - Form
    - Keeping the shoulders relaxed and away from the ears
    - Gently tucking the chin
    - Lifting the shoulder blades off the floor
    - Lifting the feet off the floor and bringing the knees up over the hips
- ♦ Back extension
  - Prime mover: erector spinae

- Form
    - Keeping the chin and spine in a neutral position
    - Squeezing the glutes
- Isolation and activation
  - ♦ Isolation exercises: single-joint exercises that primarily activate an individual muscle or muscle group
  - ♦ Activation exercises: low-intensity exercises that bring on additional blood flow and activate the nervous control of a muscle; often used as part of a specific warm-up or as part of corrective exercise programming
  - ♦ Corrective exercise: exercise programming used to improve function through assessing and improving muscle imbalances
  - ♦ Seated calf raise
    - Prime mover: gastrocnemius, soleus
    - Form
      - Raising onto the toes
      - Pressing the heels toward the floor at the bottom
  - ♦ Incline bench fly
    - Prime mover: pectoralis major, anterior deltoid
    - Form
      - Head, shoulders, and low back supported on the bench
      - Feet are flat on the floor
      - Avoiding hyperextending (arching) the spine during the eccentric lowering of the weight
  - ♦ Bent-over reverse fly
    - Prime movers: rhomboids, rear deltoid
    - Form
      - Hinging at the hips
      - Maintaining a flat back
      - Minimizing torso movement
  - ♦ Dumbbell front raise
    - Prime mover: anterior deltoid
    - Form
      - Keeping the shoulders relaxed and away from the ears
      - Raising to approximately chest height
  - ♦ Leg extension
    - Prime mover: quadriceps
    - Form
      - Keeping the shoulders, glutes, and low back on the seat

- ♦ Dumbbell lateral raise
  - Prime mover: anterior deltoid
  - Form
    - Soft bend in the knees
    - Keeping the shoulders relaxed and away from the ears
- ♦ Prone leg curl
  - Prime movers: hamstrings
  - Form
    - Knees should be aligned with the pivot point of the machine
    - Keeping the upper body still
- ♦ Machine hip adduction
  - Prime movers: adductor group
  - Form
    - Keeping the glutes, low back, and shoulders on the seat
    - Squeezing the legs toward the midline of the body
- ♦ Machine hip abduction
  - Prime mover: gluteus medius, gluteus minimus
  - Form
    - Keeping the glutes, low back, and shoulders on the seat
    - Pressing the knees into the pad to abduct the legs from the midline
- ♦ Cable triceps pushdown
  - Prime mover: triceps brachii
  - Form
    - Rolling the shoulders down and back
    - Keeping a soft bend in the knees
- ♦ Dumbbell biceps curl
  - Prime mover: biceps brachii
  - Form
    - Keeping the elbows close to the body
    - Flexing the elbow to move the weight toward the shoulder

## Cardiovascular Exercise - Chapter 11

The principles and components of program design are a common thread through all areas of physical fitness, from warm-up to flexibility, strength training, and cardiovascular work. Each principle and component helps explain how best to program cardiovascular training for each client. How long, how hard, and how often clients train are determined by the underlying principles.

- Cardiovascular fitness: the capacity to take in, transport, and utilize oxygen; specifically, the efficiency at which the heart and lungs can provide oxygen-rich blood to working muscle tissue
  - ▶ Benefits of cardiovascular exercise:
    - ♦ Reduces fatigue
    - ♦ Improves energy levels
    - ♦ Reduces depression
    - ♦ Reduces stress and anxiety
    - ♦ Prevents some types of cancer
    - ♦ Improves sleep
      - Sleep deprivation: achieving a less than ideal sleep duration.
      - Sleep recommendations

THE NATIONAL SLEEP FOUNDATION'S SLEEP RECOMMENDATIONS BY AGE GROUP		
Newborns	0–3 months	14–17 hours
Infants	4–11 months	12–15 hours
Toddlers	1–2 years	11–14 hours
Preschoolers	3–5 years	10–13 hours
School-age children	6–13 years	9–11 hours
Teenagers	14–17 years	8–10 hours
Younger adults	18–25 years	7–9 hours
Adults	26–64 years	7–9 hours
Older adults	65+ years	7–8 hours

- ♦ Improves mental acuity (sharpness of the mind, determined by memory, focus, concentration, and understanding)

## ► Key terms

- ♦ Target heart rate (THR): estimated beats per minute that need to be reached to achieve a specific exercise intensity
  - Calculated with estimated maximum heart rate and desired training zone
- ♦ Aerobic: WITH oxygen
  - Aerobic exercise: exercise that improves or is intended to improve the efficiency of the body's cardiorespiratory system in absorbing and transporting oxygen
- ♦ Anaerobic: WITHOUT oxygen
  - Anaerobic exercise: short-duration muscle contractions that break down glucose without using oxygen.
- ♦ Rates of perceived exertion (RPE): subjective sliding scale of a client's perception of their exercise intensity

BORG RPE	MODIFIED RPE	BREATHING, TALK TEST	THR (PERCENT OF MAX HR)	EXERCISE TYPE
6	0	No exertion	50–60 percent	Warm-up
7		Very light breathing. Can sing “Happy Birthday” easily.		
8	1			
9				
10	2	Deeper breathing but comfortable. Able to hold a conversation.	60–70 percent	Recovery
11				
12	3			
13				
14	4			
15	5	Starting to breathe hard and getting uncomfortable to carry a conversation	80–90 percent	Anaerobic
16	6			
17	7	Deep and forceful breathing. Uncomfortable and unable to talk.	90–100 percent	High intensity, VO <sub>2</sub> max
18	8			
19	9	Extremely hard		
20	10	Maximum exertion		



- ♦ Talk Test: the ability to speak during exercise as a gauge of the relative intensity
- ♦ Heart rate zones: percentages of maximum heart rate associated with a desired physiological adaptation
  - There are five heart rate zones that generally correspond with exercise intensities

**ZONE 1 • 50-60% Max HR**

Very light activity, such as warm-up/cooldown

**ZONE 2 • 61–70% Max HR**

Light activity, such as slow-paced jogging, walking up a flight of stairs, lightweight low resistance

**ZONE 3 • 71–80% Max HR**

Moderate activity that increases aerobic endurance, such as moderate jogging, cycling, or rowing

**ZONE 4 • 81–90% Max HR**

Hard anaerobic activity, such as high rep ball slams, boxing, or heavy weight lifting

**ZONE 5 • 91–100% Max HR**

Extreme hard maximum exertion activity, such as sprinting. All out effort!

- ♦ Maximum heart rate: average maximum number of times the heart should beat per minute during exercise
  - Calculated by subtracting a person's age from 220
- ♦ Karvonen formula:
  - The formula used to estimate a target heart rate with consideration of heart rate reserve and resting heart rate
- ♦ Tidal volume: the lung volume representing the normal volume of air displaced between normal inhalation and exhalation when extra effort is not applied
  - During exercise, tidal volume typically increases as breathing becomes deeper
  - The average healthy adult's breathing rate increases to 35 to 45 breaths per minute based on intensity during exercise as their tidal volume also increases
- ♦ Vital capacity: the greatest volume of air that can be expelled from the lungs after taking the deepest possible breath
  - For healthy adults, typically measures around 3,000 to 5,000 mL, depending on age, sex, height, and mass
  - Factors that influence tidal volume and vital capacity:
    - Age: lungs are at their maximum capacity during early adulthood and decline with age
    - Sex: female reproductive hormones lower aerobic power and pulmonary function
    - Body size: smaller bodies naturally have a smaller lung capacity
    - Physical conditioning: lung capacity improves (up to about 15%) with frequent aerobic exercise

- ♦ Metabolic equivalent (MET): the measure of the ratio of a person's expended energy to their mass while performing physical activity
  - $\text{METS} \times 3.5 \times \text{Bodyweight (KG)} / 200 = \text{Calories per Minute}$
  - One (1) MET is equal to a person's metabolic rate when at rest.
    - One (1) MET is approximately 3.5 mL of oxygen consumed per kilogram of body weight
- ♦ Resting heart rate (RHR): the measure of heart rate when completely at rest
- ♦  $\text{VO}_2$  max: the maximum amount of oxygen an individual can utilize during exercise
- ♦ Heart rate reserve (HRR): maximum heart rate minus resting heart rate
- ♦ Lactate threshold: the maximum effort or intensity an individual can maintain for an extended time with minimal effect on blood lactate levels
- ♦ Ventilatory threshold (VT): the threshold where ventilation increases faster than the volume of oxygen
- ♦ Minute ventilation: the total amount of air entering the lungs over the course of one minute.
- Applying cardiovascular training
  - ♦ One application is cross-training, or using several modes of training to develop a specific component of fitness
  - ♦ Take into account any necessary modifications the client may require; be cautious when having clients perform cardio on rowing machines since poor form can cause injury
  - ♦ The acute variables that can be manipulated to affect intensity are the following
    - Rest: decrease rest time to increase intensity
    - Resistance: increase resistance to increase intensity
    - Speed: increase speed to increase intensity
  - ♦ There are six standardized types of cardiovascular training. Each is a slight modification of the acute variables as well:
    - Low intensity, long duration or low-intensity steady state (LISS): cardiorespiratory exercise between 60 and 75 percent of maximum heart rate that remains within the aerobic threshold
    - Moderate intensity, medium duration: 70 to 85 percent of maximum heart rate effort that aims to remain aerobic. For untrained clients, the percent of maximum heart rate may be lower.
    - High intensity, short duration or high-intensity interval training (HIIT): 80 percent of maximum effort or greater during work periods, with lower-intensity rest periods that are long enough to allow the heart rate to recover
    - Aerobic intervals: sub-maximum effort during work periods to remain within the aerobic threshold
    - Anaerobic intervals (Tabata): maximum effort during 20-second work periods with short 10-second complete rest for eight rounds or four minutes total. RPE 10 effort.
    - Fartlek ("speed play" in Swedish): an outdoor running style that uses landmarks and terrain to increase or decrease running speed. Fartlek training is a way to modify several variables at once. There are two common types of Fartlek workouts: time-based and random.

- ♦ Altitude training includes training at altitudes greater than 2,500 meters above sea level with the goal of increasing the blood's oxygen-carrying capacity
  - Specifically, there is an increase in erythropoietin (EPO)
- Adaptations of cardiovascular exercise
  - ▶ Metabolic changes in muscle tissue, including an increase in mitochondria and myoglobin.
    - ♦ Myoglobin: a protein in muscle cells that carries and stores oxygen.
  - ▶ Angiogenesis: the development of new blood vessels.
  - ▶ Improves aerobic capacity
    - ♦ Aerobic capacity: a measure of the ability of the heart and lungs to get oxygen to the muscles.
  - ▶ Strengthens the heart muscle, lungs, and blood vessels
  - ▶ Improves the pumping capacity of the heart

## Resistance Training - Chapter 12

- Also called strength training; exercise with the explicit intent of increasing strength, endurance, muscle size (hypertrophy), or power
  - ▶ Training adaptations
    - ♦ Muscular endurance: the ability of a muscle or group of muscles to continuously exert force against resistance over time
    - ♦ Hypertrophy: an increase in muscular size as an adaptation to exercise
      - Two sessions per week per muscle group is recommended for hypertrophy
      - Atrophy: the wasting away or loss of muscle tissue
        - May occur as soon as two weeks after training stops
    - ♦ Strength: the amount of force that can be created by a muscle or group of muscles
    - ♦ Power: the amount of force exerted by a muscle or group of muscles in a given amount of time
  - ▶ Strength categories
    - ♦ Relative strength: the individual's body weight in relation to the amount of resistance they can overcome
      - Calculation:  $1RM / \text{body weight} = \text{force per unit of body weight}$
    - ♦ Maximum strength: the ability of a muscle or muscle group to recruit and engage as many muscle fibers as possible
    - ♦ Starting strength: The ability to recruit as many motor units as possible instantaneously at the start of a movement.
    - ♦ Power: a combination of strength and speed; a muscle's ability to generate maximal tension as quickly as possible
      - Power is a function of strength.
      - Power is defined by the equation:
        - $\text{Force} \times \text{distance} / \text{time}$
        - ♦ Force is mass times acceleration:  $F = M \times A$
    - ♦ Speed strength: the ability of a muscle or muscle group to absorb and transmit forces quickly

► Classifying strength

- ♦ Linear strength: two or more strength variables that are directly correlated to one another
  - Example: maximal strength and muscular power
  - Linear strength endurance activity: activity that requires a sustained, all-out maximum effort for an extended period.
- ♦ Nonlinear strength: two or more strength variables that are not directly correlated to one another
  - Nonlinear strength endurance activity: an activity with intermittent activity and rest periods.
- ♦ Anaerobic strength
  - Derive energy from the ATP/CP energy pathway and anaerobic glycolysis
- ♦ Aerobic strength
  - Endurance strength: the ability to sustain a submaximal activity for a longer duration.

► Benefits of strength training

- ♦ Increased lean mass
- ♦ Increased resting metabolic rate
- ♦ Promotes bone development
- ♦ Increase HDL the “good” lipoprotein and decrease LDL the “bad” lipoprotein

► Strength Curves

- ♦ Ascending strength curve
  - More force is applied toward the end range of motion than during the beginning or middle phase
- ♦ Descending strength curve
  - More force is applied toward the beginning range of motion than during the middle or end phase
- ♦ Bell-shaped strength curve
  - The beginning and ending phases of movement are more difficult than the middle
  - Example: Biceps curl

► General exercises: foundational exercises that train overall strength

- ♦ Isolation exercises: single-joint exercises that primarily activate an individual muscle or muscle group
- ♦ Compound exercises: multi-joint movement exercises that require the use of multiple muscles or muscle groups

► Specific exercises: exercises that directly improve performance and functional capacity and mimic a target activity or skill

- ♦ Cross-body exercises: more closely mimic the natural movement of the body in space such as walking
- ♦ Explosive exercises: engage many muscles in a sequential, powerful, quick movement

► Training variables and methods

- ♦ Split-routine: the division of training sessions by body part or body region
- ♦ Intensity
  - One-repetition max (1RM): a single maximum-strength repetition with maximum load.

- ♦ Tapering: a planned reduction in training to avoid detraining and increase gains prior to competition.
  - Should meet three objectives:
    - To reduce fatigue as much as possible
    - To increase or maintain fitness at competition levels
    - To enhance specificity
- ♦ Types of grip used for lifting
  - Supinated: the palm faces up toward the ceiling.
  - Pronated: the hand or forearm is rotated, and the palm faces down or back
  - Neutral: the palms face each other (facing the body's midline)
  - Alternated: one hand grasps the bar in a supinated position, while the other grasps the bar in a pronated position
  - Hook: the barbell is held by gripping the thumb between the barbell and fingers
  - Open: the thumb does not wrap around the bar
  - Closed: the hand wraps fully around the bar
- ♦ Rep and set schemes
  - Single set: the use of one set per exercise or muscle group
  - Multiset: multiple sets per exercise or muscle group
  - Straight sets: the use of the same weight for every set
  - Supersets: two exercises, typically opposing muscle groups, performed back-to-back followed by a short rest
  - Drop set: technique in which a set is done until failure or fatigue, the weight is “dropped” or lowered, and the exercise continues until another failure; can continue for several rounds.
  - Ascending pyramids: lighter weights are used to start the workout, and they get progressively higher with subsequent sets
  - German volume training: a method in which 10 sets of 10 repetitions are done of an exercise with one minute of rest between sets
- ♦ Free weights: loads that are not attached to an apparatus
- ♦ Weight machines: pieces of equipment with fixed or a variable range of motion that uses gravity and a load to generate resistance
- ♦ Partial repetitions: exercise movements performed through a limited range of motion.
- ♦ Functional isometrics: the combination of partial repetition training and isometric holds.
- ♦ Body weight exercises: movements performed with no additional load other than what the exerciser's body provides
  - Ideal for a client who is new to strength training and learning new movement patterns
- ♦ Constant resistance: the resistance (weight) of the exercise does not change
  - Barbells, dumbbells, kettlebells, and medicine balls are categorized as constant resistance equipment
- ♦ Variable resistance: the resistance changes throughout the range of motion
  - Includes rubber-based resistance such as loops, tubes, and bands, as well as chains

## ♦ Acute training variables for adaptation

## – Muscular endurance

EXERCISE	LOAD/ INTENSITY	SETS	REPS	TEMPO	REST
Push-ups	67 percent or less	1–3 sets	15 or more	4:0:6:0	30–60 seconds
Assisted pull-ups	67 percent or less	1–3 sets	15 or more	4:0:6:0	30–60 seconds
Goblet squats	67 percent or less	1–3 sets	15 or more	4:0:6:0	30–60 seconds
Dumbbell Romanian Deadlift (RDL)	67 percent or less	1–3 sets	15 or more	4:0:6:0	30–60 seconds

## – Hypertrophy

EXERCISE	LOAD/ INTENSITY	SETS	REPS	TEMPO	REST
Dumbbell chest press	67–85 percent	3–5 sets	6–12	3:1:3:1	30–60 seconds
Dumbbell chest fly	67–85 percent	3–5 sets	6–12	3:1:3:1	30–60 seconds
Chest press machine	67–85 percent	3–5 sets	6–12	3:1:3:1	30–60 seconds
Triceps extension pushdown	67–85 percent	3–5 sets	6–12	3:1:3:1	30–60 seconds

## – Strength

EXERCISE	LOAD/ INTENSITY	SETS	REPS	TEMPO	REST
Barbell chest press	85 percent or greater	3–5 sets	1–6	3:0:1:0	2–5 minutes
Dumbbell incline press	85 percent or greater	3–5 sets	1–6	3:0:1:0	2–5 minutes
Barbell row	85 percent or greater	3–5 sets	1–6	3:0:1:0	2–5 minutes
Seated cable row	85 percent or greater	3–5 sets	1–6	3:0:1:0	2–5 minutes

## – Power

EXERCISE	LOAD/ INTENSITY	SETS	REPS	TEMPO	REST
Jump squats	75–85 percent	3–5 sets	1–5	Fastest controllable tempo	1–2 minutes
Plyometric push-ups	75–85 percent	3–5 sets	1–5	Fastest controllable tempo	1–2 minutes
Overhead medicine ball throw	75–85 percent	3–5 sets	1–5	Fastest controllable tempo	1–2 minutes
Medicine ball soccer throw	75–85 percent	3–5 sets	1–5	Fastest controllable tempo	1–2 minutes